Application No. 09/809,090
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Art Unit 2881

The Claims

1. Detector for a time-of-flight mass spectrometer comprising:

an electron multiplier, for converting a charged particle into a multiplicity of electrons;

a scintillator, for converting the multiplicity of electrons into a multiplicity of photons; and

a charge collector disposed for receiving the multiplicity of photons and adapted for reconverting said photons into a second multiplicity of electrons and integrating said second multiplicity of electrons into a charge pulse corresponding to the mass of the charged particle;

whereby said charge collector is electro-optically isolated from said electron multiplier.

2. Detector of claim 1, wherein said charge collector comprises a photomultiplier for converting the multiplicity of photons into the second multiplicity of electrons.

3. Detector of claim 2, wherein said photomultiplier is adapted for summing the second multiplicity of electrons into the charge pulse.

4. Detector of claim 1, wherein said electron multiplier comprises a coating formed on a surface thereof, said coating being formed of a material selected from the group consisting of aluminum oxide (Al_2O_3), magnesium oxide (MgO), tin oxide (SnO_2), quartz (SiO_2), barium fluoride (BaF_2), rubidium tin (Rb_3Sn), beryllium oxide (BeO), diamond and combinations thereof

5. Detector of claim 1, wherein said electron multiplier comprises a microchannel plate.

6. Detector of claim 5 comprising a cartridge configured to receive said microchannel plate, said cartridge being readily removable from and installable in said detector.

7. Detector of claim 1, wherein said scintillator is configured to provide a frequency bandwidth which accommodates arrival times of the multiplicity of electrons.

8. Detector of claim 1, wherein said scintillator is constructed from "BICRON" 418 or "BICRON" 422b.

9. Detector of claim 1, further comprising a conductive coating on said scintillator configured to reflect photons generated therein.

10. Detector of claim 9, wherein the conductive coating on said scintillator is selected from the group consisting of aluminum, chrome and combinations thereof.

11.(Withdrawn) Electron multiplier having a coating selected from aluminum oxide (Al_2O_3), magnesium oxide (MgO), tin oxide (SnO_2), quartz (SiO_2), barium flouride (BaF_2), rubidium tin (Rb_3Sn), berrylium oxide (BeO), diamond and combinations thereof

12.(Withdrawn) Electron multiplier of claim 11, defining a multichannel plate.

13. Method of detecting a charged particle with a time-of-flight mass spectrometer having a high voltage portion and a detector, said method comprising the steps of:

accelerating a charged particle with a voltage;

converting the charged particle into a multiplicity of electrons

converting the multiplicity of electrons into a multiplicity of photons;

collecting the multiplicity of photons, thereby electro-optically isolating the detector from the high voltage portion of the time-of-flight mass spectrometer;

converting the multiplicity of photons into a second multiplicity of electrons; and then

integrating the second multiplicity of electrons into a charge pulse.

14. Method of claim 13, wherein the step of converting the charged particle is achieved by using a microchannel plate.

15. Method of claim 14, further comprising the step of enhancing secondary electron emissivity of the microchannel plate with a coating selected from aluminum oxide (Al_2O_3), magnesium oxide (MgO), tin oxide (SnO_2), quartz (SiO_2), barium fluoride (BaF_2), rubidium tin (Rb_3Sn), beryllium oxide (BeO), diamond and combinations thereof.

16. Method of claim 13, wherein the voltage ranges from - 15kV to + 15kV.

17. Method of claim 15, wherein said converting the particle is achieved with a multichannel plate.

18.(Canceled)

19.(Canceled)

20. Method of claim 13, wherein said converting the photons is achieved with a scintillator.

21. Method of claim 20, wherein the scintillator is configured to provide a frequency bandwidth which accommodates arrival times of the multiplicity of electrons.

22. Method of claim 20, wherein the scintillator is constructed from BICRON 418 or BICRON 422b.

23. Method of claim 20, wherein the scintillator has a conductive coating thereon for reflecting photons generated therein.

24. Method of claim 20, wherein the scintillator has a conductive coating thereon selected from aluminum, chrome and combinations thereof.

25. Detector for a time-of-flight mass spectrometer comprising:

an electron multiplier, for converting particles into a multiplicity of first electrons;

a scintillator, for converting the multiplicity of first electrons into a multiplicity of

photons; and

a photomultiplier for converting the multiplicity of photons into a second multiplicity of
electrons.

whereby said detector is electro-optically isolated from a high voltage portion of the
time-of-flight mass spectrometer.

26. Detector for a time-of-flight mass spectrometer responsive to input particles, each having a corresponding mass, for producing output pulses representative of the respective masses of the particles, comprising:

a biased input for differentially accelerating each input particle in accordance with its mass;

a first electron multiplier, for converting the accelerated input particle into a corresponding multiplicity of first electrons;

a scintillator, responsively coupled to the first electron multiplier for converting the multiplicity of first electrons into a multiplicity of corresponding photons; and

a second electron multiplier responsively coupled to the scintillator for converting the multiplicity of photons into a corresponding second multiplicity of electrons, said second electron multiplier being electrically isolated from the scintillator.

27. Detector for a time-of-flight mass spectrometer responsive to input particles, each having a corresponding mass, for producing output pulses representative of the respective masses of the particles, comprising:

a biased input for differentially accelerating each input particle in accordance with its mass;

a microchannel plate electron multiplier, for converting the accelerated input particle into a corresponding multiplicity of first electrons;

a scintillator, responsively coupled to the microchannel plate electron multiplier for converting the multiplicity of first electrons into a multiplicity of corresponding photons; and

a photomultiplier tube electron multiplier responsively coupled to the scintillator for converting the multiplicity of photons into a corresponding second multiplicity of electrons, said photomultiplier tube electron multiplier being electrically isolated from the scintillator.

28. Detector of claim 25, wherein said photomultiplier is adapted for summing the second multiplicity of electrons into the charge pulse.

29. Detector of claim 25, wherein said electron multiplier comprises a coating formed on a surface thereof, said coating being formed of a material selected from the group consisting of aluminum oxide (Al_2O_3), magnesium oxide (MgO), tin oxide (SnO_2), quartz (SiO_2), barium fluoride (BaF_2), rubidium tin (Rb_3Sn), beryllium oxide (BeO), diamond and combinations thereof

30. Detector of claim 25, wherein said electron multiplier comprises a microchannel plate.

31. Detector of claim 30 comprising a cartridge configured to receive said microchannel plate, said cartridge being readily removable from and installable in said detector.

32. Detector of claim 25, wherein said scintillator is configured to provide a frequency bandwidth which accommodates arrival times of the multiplicity of electrons.

33. Detector of claim 25, wherein said scintillator is constructed from "BICRON" 418 or "BICRON" 422b.

34. Detector of claim 25, further comprising a conductive coating on said scintillator configured to reflect photons generated therein.

35. Detector of claim 34, wherein the conductive coating on said scintillator is selected from the group consisting of aluminum, chrome and combinations thereof.

36. Detector of claim 26, wherein said charge collector comprises a photomultiplier for converting the multiplicity of photons into the second multiplicity of electrons.

37. Detector of claim 36, wherein said photomultiplier is adapted for summing the second multiplicity of electrons into the charge pulse.

38. Detector of claim 26, wherein said electron multiplier comprises a coating formed on a surface thereof, said coating being formed of a material selected from the group consisting of aluminum oxide (Al_2O_3), magnesium oxide (MgO), tin oxide (SnO_2), quartz (SiO_2), barium fluoride (BaF_2), rubidium tin (Rb_3Sn), beryllium oxide (BeO), diamond and combinations thereof

39. Detector of claim 26, wherein said electron multiplier comprises a microchannel plate.

40. Detector of claim 39 comprising a cartridge configured to receive said microchannel plate, said cartridge being readily removable from and installable in said detector.

41. Detector of claim 26, wherein said scintillator is configured to provide a frequency bandwidth which accommodates arrival times of the multiplicity of electrons.

42. Detector of claim 26, wherein said scintillator is constructed from "BICRON" 418 or "BICRON" 422b.

43. Detector of claim 26, further comprising a conductive coating on said scintillator configured to reflect photons generated therein.

44. Detector of claim 43, wherein the conductive coating on said scintillator is selected from the group consisting of aluminum, chrome and combinations thereof.

45. Detector of claim 27, wherein said photomultiplier is adapted for summing the second multiplicity of electrons into the charge pulse.

46. Detector of claim 27, wherein said electron multiplier comprises a coating formed on a surface thereof, said coating being formed of a material selected from the group consisting of aluminum oxide (Al_2O_3), magnesium oxide (MgO), tin oxide

(SnO_2), quartz (SiO_2), barium fluoride (BaF_2), rubidium tin (Rb_3Sn), beryllium oxide (BeO), diamond and combinations thereof

47. Detector of claim 27 comprising a cartridge configured to receive said microchannel plate, said cartridge being readily removable from and installable in said detector.

48. Detector of claim 27, wherein said scintillator is configured to provide a frequency bandwidth which accommodates arrival times of the multiplicity of electrons.

49. Detector of claim 27, wherein said scintillator is constructed from "BICRON" 418 or "BICRON" 422b.

50. Detector of claim 27, further comprising a conductive coating on said scintillator configured to reflect photons generated therein.

51. Detector of claim 50, wherein the conductive coating on said scintillator is selected from the group consisting of aluminum, chrome and combinations thereof.